U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: Moxostoma sp.

COMMON NAME: Sicklefin redhorse

LEAD REGION: 4

INFORMATION CURRENT AS OF: September 2005

STATUS/ACTION

___ Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status

__New candidate

_X__ Continuing candidate

_X__ Non-petitioned

___ Petitioned - Date petition received:

__ 90-day positive - FR date:

__ 12-month warranted but precluded - FR date:

__ Did the petition request a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES:

a. Is listing warranted (if yes, see summary of threats below)?

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions?

c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded.

Former LP: ___

New LP: ___

Date when the species first became a Candidate (as currently defined): 5/11/05

___ Candidate removal: Former LP: ___

___ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.

___U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.

___ F – Range is no longer a U.S. territory.

___ I – Insufficient information exists on biological vulnerability and threats to support listing.

___ M – Taxon mistakenly included in past notice of review.

___ N – Taxon does not meet the Act's definition of "species."

___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Fish; Catostomidae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: TN, NC, & GA

CURRENT STATES/ COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: NC & GA

LAND OWNERSHIP
Approximately 95 percent of the lands bordering Hiwassee Lake and approximately 50 percent of the lands bordering Fontana Reservoir are within the boundaries of the Nantahala National Forest; approximately an additional 40 percent of the lands bordering Fontana Reservoir are within the boundaries of the Great Smoky Mountains National Park; approximately 65 percent of the lands bordering the riverine portion mainstem of the Little Tennessee River inhabited by the sicklefin redhorse are owned by the state of North Carolina and are managed by the North Carolina Wildlife Resources Commission; and, a small percentage of the Tuckasegee River and Hanging Dog Creek are bordered by lands belonging to The Eastern Band of Cherokee Indians. The remaining streams and stream reaches currently occupied by the sicklefin redhorse, with the exception of state roads and highway rights-of-way, are bordered by lands in private ownership.

LEAD REGION CONTACT: Richard (Rick) Gooch, Atlanta, Georgia Regional Office (404/679-7124)

LEAD FIELD OFFICE CONTACT: Asheville Field Office, NC; John Fridell; (828) 258 3939 x 225

BIOLOGICAL INFORMATION
Unless otherwise cited, the following is adapted from Jenkins 1999, and personal communications with Dr. Robert Jenkins, Department of Biology, Roanoke College, Salem, Virginia, 2000-2005.

Species Description: The sicklefin redhorse, a fish, can grow to a length of approximately 445 millimeters (roughly 18 inches), with an elongate, somewhat compressed, body and a highly falcate (sickle-shaped) dorsal fin. Its body is olive colored, with a coppery or brassy sheen; its lower fins (pectoral, pelvic, and anal fins) are primarily dusky to dark, often tinted yellow or orange and pale edged; the caudal fin (tail fin) is mostly red; and its dorsal fin (back fin) is olive in color, sometimes partly red. Based on an analysis of preserved specimens, the species is relatively long lived, with both sexes living at least to 17 years of age; however, based on the size of fish seen in the streams, some individuals probably live for over 20 years.

Taxonomy: Although the sicklefin redhorse is now known to have been collected in 1937, based upon preserved specimens collected at the then unimpounded mouth of Forney Creek, near its confluence with the Tuckasegee River, it was not recognized as a distinct species until 1992, when Dr. Jenkins obtained and examined two specimens collected from the Little Tennessee River in 1981 and 1982 by Dr. Edward Menhinick, University of North Carolina at Charlotte, Charlotte, North Carolina. Based on the characteristics of specimens' lower lips, dorsal fins, and pharyngeal teeth, Dr. Jenkins recognized the species as possibly a previously unidentified

species or a hybrid of the smallmouth (=hookfin) redhorse (*M. breviceps*) and the river redhorse (*M. carinatum*). Subsequent detailed morphological studies and genetic studies (Harris et. al. 2002) have concluded that the sicklefin redhorse is, in fact, a distinct species. Dr. Jenkins is currently working on publishing a formal description of this species.

Habitat: The species is currently known to occupy cool to warm, moderate gradient creeks and rivers, and, during parts of its early life stages, large reservoirs. In streams, it is most often observed in riffles, runs, and well-flowing pools. It feeds and spawns in gravel, cobble, and boulder substrates with no, or very little, silt overlay. Like many other redhorse species, the sicklefin redhorse is known mainly from flowing streams; however, also like many other redhorse species, the sicklefin redhorse appears to have adapted to spending at least part of its life in the near-shore areas of impounded streams. Current observations indicate that adults are year-round residents of rivers and large creeks and that young, juveniles, and subadults occupy primarily the lower reaches of creeks and rivers and near-shore portions of certain reservoirs. It is likely that after emerging from the stream substrata, many of the larvae and postlarvae are carried downstream to the mouths of streams or into reservoirs. Newly mature fish ($\geq$5 years of age) appear to migrate from the reservoirs to spawn and then remain in the streams with the other adults.

Stomach analysis indicates that the sicklefin redhorse feeds on benthic invertebrates (insect larvae, crustaceans, snails, etc.) that it gathers from the surface of clean gravel, cobble, bedrock, sticks, and logs. It has rarely been observed foraging on substrates with even a thin covering of silt. Spawning typically occurs over cobble, with usually only a small portion of sand and gravel, in moderate to fast runs in open areas and pockets formed by boulders and outcrops. The spawning period for the sicklefin runs from late April through mid-May.

Historical and Current Range/Distribution: Past and recent collection records of the sicklefin redhorse, together with what is known about the habitat utilization of the species, indicate that the sicklefin redhorse once inhabited the majority, if not all, of the rivers and large creeks in the Blue Ridge portion of the Hiwassee and Little Tennessee River systems in North Carolina, Tennessee, and Georgia. Currently, however, there are only two meta-populations of the species known to survive – one in the Hiwassee River system and one in the Little Tennessee River system.

In the Hiwassee River system, the species has been documented in recent years in (1) a relatively short reach (approximately 9.0 miles) of the main stem of the Hiwassee River, between Mission Reservoir and Hiwassee Lake, Cherokee County, North Carolina, and Brasstown Creek (approximately 16.9 miles), a tributary to this reach of the Hiwassee River in Cherokee County, North Carolina, and Town County, Georgia; (2) Hanging Dog Creek (approximately 0.2 mile), a tributary to Hiwassee Lake in Cherokee County, North Carolina; and (3) the main stem of the Valley River, between the town of Andrews and Hiwassee Lake (approximately 22.3 miles), Cherokee County, North Carolina. In addition, juveniles have been collected from the near-shore portions of Hiwassee Lake, Cherokee County, North Carolina. No adult sicklefin redhorse have been observed from Hiwassee Reservoir or Hanging Dog Creek, indicating that these areas likely serve only as nursery sites for sub-adult sicklefins and not as spawning or

foraging habitat for adults of the species. The Hiwassee River and Valley River are connected by Hiwassee Lake, so it is likely that some genetic interchange is occurring between these streams. Estimate occupied stream habitat in the Hiwassee river systems totals about 48.4 miles.

The Little Tennessee River system meta-population of the sicklefin redhorse includes a total of only approximately 41.65 miles of creek and river reaches, plus nearshore areas of a reservoir, including: (1) the main stem of the Little Tennessee River in Macon and Swain Counties, North Carolina, between Lake Emory Dam and Fontana Reservoir (approximately 24.2 river miles), and its tributaries, Burningtown Creek (approximately 3.1 river miles) and Iotla Creek (approximately 0.1 river mile) in Macon County, North Carolina; (2) the main stem of the Tuckasegee River in Swain County, North Carolina, from Bryson City downstream to Fontana Reservoir (approximately 11.4 miles), and its tributaries, Forney Creek (mouth of the creek), Deep Creek (approximately 2.35 river miles), and the Oconaluftee River below the Bryson/Smoky Mountain Dam (approximately 0.5 river mile), in Swain County, North Carolina; and, (3) juveniles of the species have been collected in the near-shore portions of Fontana Reservoir, Swain County, North Carolina. Like Hiwassee Reservoir, no adult sicklefin redhorse have been observed in Fontana Reservoir or Forney Creek (lower reaches of Forney Creek are impounded by Hiwassee reservoir), indicating that these areas likely serve only as nursery sites for sub-adult sicklefin rehorse. Likely adult spawning and foraging habitat in the Little Tennessee River system appears to be restricted to the Little Tenneessee River and its tributaries, Burningtown Creek and possibly the lower Iotla Creek, and the Tuckasegee River and its tributaries, the lower Oconaluftee River and possibly the lower reaches Deep Creek (a single adult was observed in Deep Creek in 2000, but no sicklefins have been observed in subsequent surveys).

Population Estimates/Status: Dr. Jenkins estimates that the species has apparently been eliminated from roughly 58.4 percent of its former range. This is a conservative estimate that: (1) includes several miles of the Hiwassee and Fontana Reservoirs within the present range of the species (although portions of these reservoirs appear to provide survivable habitat for juvenile sicklefins, they do not provide foraging or spawning habitat for adults of the species although they no doubt did prior to impoundment); (2) does not include in the species' historic range some of the higher reaches of some of the creeks where the sicklefin redhorse occurs in their lowermost reaches; and (3) does not include portions of the Cheoah River, Cullasaja River, Cartoogechaye Creek, and several other large tributaries in the Hiwassee and Little Tennessee River systems that may also have been part of the historic range of the sicklefin redhorse.

THREATS :

A. The present or threatened destruction, modification, or curtailment of its habitat or range. Many populations of the species were apparently extirpated when large portions of the upper Tennessee River system that provided suitable habitat for this species were destroyed as a result of impoundments created when dams were constructed. These impoundments also resulted in fragmentation and isolation of the remaining populations, making them more vulnerable to extirpation from other environmental impacts. In addition to impoundments, factors contributing to habitat destruction and modification

that resulted in population losses and curtailment of the range of the species are believed to include inadequate erosion/ sedimentation control during agricultural, timbering, and construction activities; run-off and discharge of organic and inorganic pollutants from industrial, municipal, agricultural, and other point and nonpoint sources; habitat alterations associated with channelization and instream dredging/mining activities; and other natural and human-related factors that adversely modify the aquatic environment. As described below, many of these factors continue to threaten the surviving populations.

The construction and operation of the dams on the rivers in the Hiwassee and Little Tennessee River systems, for hydroelectric generation and flood control, are the most significant factors contributing to the extirpation of the species from much of its historic range. The impoundments created by these dams destroyed or modified stream conditions (flowing, highly oxygenated water and coarse sand, gravel, and rocky bottoms) that are suitable habitat for the sicklefin. Although additional dams are not being proposed for construction the existence and operation of the existing dams is limiting the species' expansion back into portions of streams it is believed to have once occupied.

Lakes do not naturally occur within the historic range of the sicklefin redhorse. Like the majority of our other native aquatic species in these areas, the sicklefin redhorse is adapted to stream conditions (flowing, highly oxygenated water and coarse sand, gravel, and rocky bottoms). The impoundments created by the dams eliminate spawning and foraging habitat of the adult sicklefin redhorse by changing the conditions from flowing to still water. Water depth increases, flow decreases, and silt accumulates on the bottom (Williams et al. 1992).

Impoundments not only destroy riverine habitat within the impounded portion of the stream, but they alter the quality and stability of the downstream reaches by adversely affecting water flow regimes, velocities, temperature, chemistry, and nutrient cycles (Ligon et al. 1995, Collier et al. 1996). Dams that operate by releasing cold water from near the bottom of the reservoirs lower the water temperature downstream, changing downstream reaches from warm- or cool-water streams to cold-water streams and affecting their suitability for many of the native species historically inhabiting these stream reaches (Layzer et al. 1993). The effects of impoundments result in changes in fish and macroinvertebrate communities (macroinvertebrates are the main prey items of the sicklefin), and species requiring clean gravel and sand substrates are eliminated (Bates 1962). In addition, dams result in the fragmentation and isolation of populations of species, acting as effective barriers to the natural upstream and downstream expansion or recruitment of fish species. This reduction in range and isolation of the populations greatly increases the vulnerability of a species to extinction. It reduces the species' ability to respond to changes (natural or manmade) within its environment and to recover from impacts (large or repeated small scale impacts) to its numbers that a species with widely dispersed, interconnected healthy populations would likely be able to overcome.

Within the Valley River and Brasstown Creek in the Hiwassee River system, the species

likely still inhabits the same length of stream that it did historically; the small size of the upper reaches of these streams are thought to be the major factor limiting the species' current upstream distribution. These are the only two steams where the sicklefin redhorse currently spawns that do not have impoundments on them. The sicklefin's historic range in the mainstem of the Hiwassee River in North Carolina is believed to have extended much further upstream, likely at least to the North Carolina/Georgia state line. The construction of the Mission Dam fragmented the species' range in this river, isolating the upstream portion of the population and prohibiting recruitment from the downstream population segment. The species no longer occurs upstream of Mission Dam. Alterations of flow and stream temperature associated with the construction and operation of the dam at Lake Chatuge on the Hiwassee River, a few miles downstream of North Carolina/Georgia state line, have been implicated, together with other impacts to habitat quality, to contributing to this loss of the species in Hiwassee River above Mission Reservoir. Likewise, the Appalachia Dam and Hiwassee Dam, near the North Carolina/Tennessee state line, prohibit downstream expansion/repopulation of the surviving Hiwassee River system population into the rest of the Blue Ridge portion of the Hiwassee River downsteam in Tennessee. The Hiwassee Dam impounds about 22.2 miles of the Hiwassee River; Appalachia Dam impounds roughly 9.8 miles of river; and water from Hiwassee Lake is piped and "dewaters" (bypasses) an additional 8.3 miles of river channel below the dam, to the Appalachia Powerhouse in Polk County, Tennessee. The discharge from the powerhouse is a cold water discharge effecting stream temperatures in the river channel for several more miles downriver.

Also, the Little Tennessee River population of the sicklefin redhorse in the mainstem of the Little Tennessee River and the portion of the population in Tuckasegee River and Oconaluftee Rivers has been fragmented and adversely affected by the construction and operation of hydroelectric dams. Construction of the Porters Bend Dam on the Little Tennessee River, Dillsboro Dam on the Tuckasegee River, and the Bryson/Smoky Mountain Dam on the Oconaluftee River resulted in the fragmentation of the species' ranges in these rivers. Once isolated, the remaining portions of the population of the species in these streams above these dams are believed to have been extirpated by the general deterioration of water and habitat quality associated with wastewater discharges and runoff of silt and other pollutants from development, agriculture, and forestry activities implemented without adequate stormwater and erosion control measures. In the case of the Tuckasegee River, the effects on flow and water temperatures associated the construction and operation of hydroelectric dams (a total of six) in its headwaters have also likely had a significant effect on the loss of the sicklefin redhorse in the upper reaches of this river.

In addition to impoundments, factors contributing to population losses are believed to include inadequate erosion/sedimentation control during agricultural, timbering, and construction activities; run-off and discharge of organic and inorganic pollutants from industrial, municipal, agricultural, and other point and nonpoint sources; habitat alterations associated with channelization and instream dredging/mining activities; and other natural and human-related factors that adversely modify the aquatic environment.

Many of these factors continue to threaten the surviving populations.

The sicklefin redhorse has been observed feeding and spawning only in substrates with no or very little silt accumulation. Excessive siltation and suspended sediment, which can occur as a result of land disturbance activities with inadequate erosion and stormwater controls, affects the habitat of the sicklefin redhorse by making it unsuitable for feeding and reproduction. It eliminates breeding sites and results in increased mortality of eggs and juveniles; it eliminates feeding areas, reduces the species' ability to detect prey, and eliminates aquatic insect larvae and other food items of the sicklefin. Suspended sediment also irritates and clogs fishes' gills affecting their respiration (Waters 1995).

In addition to siltation, other water pollutants threaten the species' survival, including nutrient and chemical pollutants from wastewater discharges and stormwater runoff from logging operations, row crop and life stock fields, roads and parking lots, lawns, and other non-point sources. These pollutants not only poison and kill the fish and their food items, but can adversely affect stream pH, conductivity, dissolved oxygen concentrations, and cause other changes in water chemistry which in turn affect aquatic life. Nutrients, usually phosphorus and nitrogen, originating from residential lawns, leaking septic systems, livestock operations, and agricultural fields contribute to eutrophication and reduced oxygen levels in streams.

The runoff of stormwater from cleared areas, roads, rooftops, parking lots, and other developed areas, which often is ditched or piped directly into streams, not only results in stream pollution but also results in increased water volume and velocity during heavy rains. This change in water volume and velocity causes channel and stream-bank scouring that leads to the degradation and elimination of aquatic habitat. Construction and land-clearing operations are particularly detrimental when they result in the alteration of floodplains or the removal of forested stream buffers that ordinarily would help maintain water quality and the stability of stream banks and channels by absorbing, filtering, and slowly releasing rainwater. Also, when storm water runoff increases from land-clearing activities, less water is absorbed to recharge ground water levels. Therefore, flows during dry months can decrease and adversely affect aquatic resources.

B. Overutilization for commercial, recreational, scientific, or educational purposes.

The species presently has no commercial value, and other collecting is not currently known to have been a significant factor contributing to the species' decline. As evidenced by the still existing, prehistoric and early-historic rock fish weirs in the Tuckasegee and Little Tennessee rivers, the species, along with other redhorse species, was no doubt utilized at least occasionally as a food source by Native American Indians and early settlers inhabiting the watersheds of these streams. There are also anecdotal reports that as recently as 30 years ago, local residents of the areas shot and ate redhorse, the sicklefin likely included; however, other redhorse species in the Clinch River in Virginia have been "much-gunned" for decades without apparent ill effect to their

populations levels. Anglers may also on occasion harvest sicklefin along with other redhorse species; however, recreational harvest of the sicklefin by anglers is not currently believed to pose a significant threat to the species.

C. Disease or predation.

There is currently no information to indicate that disease has played a significant role in the past decline of the sicklefin redhorse. However, there are numerous fish diseases that if introduced into the rivers currently supporting the species have the potential to seriously affect population levels. The introduction of non-native diseases can be especially devastating to native fish species' populations. Fish hatcheries/farms and hobbyist ponds in the watersheds of these rivers, especially those with direct links to streams in the systems, pose a significant threat unless adequate measures are implemented to prevent the introduction and spread of pathogens from these facilities/ponds.

The early life stages (eggs, fry, and juveniles) of the sicklefin are likely preyed upon by a variety of other species. Predation by naturally occurring predators is a normal aspect of the population dynamics and is not considered to currently pose a threat to the species. However, the introduction of non-native species, especially large predators such as non-native species of catfish could pose a significant threat to the sicklefin redhorse.

D. The inadequacy of existing regulatory mechanisms.

The sicklefin redhorse does not currently have any official status in North Carolina or Georgia, though both states prohibit the collection of the fish for scientific purposes without a valid State collecting permit. However, this requirement does not provide any protection to the species from other forms of take or any protection to its habitat.

In the unimpounded portions of the mainstems of the Little Tennessee River and Tuckasegee River where the sicklefin redhorse survives, the species' habitat is indirectly provided some Federal protection from Federal actions and activities through the Endangered Species Act, due to the fact that the mainstem portions of both of these rivers that are inhabited by the sicklefin redhorse, also support, and are designated as critical habitat for, populations of the federally endangered Appalachian elktoe (*Alasmidonta raveneliana*). In addition to the Appalachian ekltoe, the portion of the Little Tennessee River where the sicklefin redhorse occurs also supports populations of the federally endangered little-wing pearlymussel (*Pegias fabula*) and a federally threatened fish species, the spotfin chub (*Erimonax monachus*) and is also designated as critical habitat for the spotfin chub. However, the sicklefin redhorse' habitat in the other streams and the two impoundments, Fontana Reservoir and Hiwassee Lake, where the species survives, is not afforded this indirect protection.

E. Other natural or manmade factors affecting its continued existence.

None are known at this time.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED
There currently are no written agreements in place specifically for this species. However, the Service has reached an agreement with Federal Energy Regulatory Commission (FERC) and Progress Energy, through a FERC relicensing section 7 consultation involving the Appalachian elktoe, for the removal of a small hydropower dam on mainstem of the Tuckasegee River that may eventually allow for the expansion of sicklefin redhorse into upstream reaches of the river. In addition, the Service has been working with biologists with the U.S. Forest Service; the Tennessee Valley Authority; the states of North Carolina, Georgia, and Tennessee; and personnel with the Roanoke College, Salem, Virginia and University of Tennessee, Knoxville, Tennessee to identify threats and potential recovery measures for the sicklefin redhorse.

SUMMARY OF THREATS
Hydroelectric operations, inadequate erosion/sedimentation control during agricultural, timbering, and construction activities; run-off and discharge of organic and inorganic pollutants from industrial, municipal, agricultural, and other point and nonpoint sources; habitat alterations associated with channelization and instream dredging/mining activities; and other natural and human-related factors that adversely modify the aquatic environment.

For species that are being removed from candidate status:
___Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions (PECE)?

RECOMMENDED CONSERVATION MEASURES Assuring the long-term survival of the sicklefin redhorse will require, at a minimum: (1) protecting the existing water and habitat quality of the reaches of the river systems were the species is still surviving; and (2) improving degraded portions of the species' habitat to allow for the expansion of existing populations and reestablishment of the extirpated populations. This will require compliance with existing State and Federal regulations, assistance from the public and local governments and industries in implementing conservation measures; and, developing agreements with power companies and other partners to provide a means of allowing the species to expand into historic habitat currently inaccessible due to dams and hydropower operations. Also, additional research is needed on the threats to the sicklefin redhorse, the species life history, the environmental requirements of the species, movement patterns, and propagation and population augmentation/reintroduction techniques for the species.

LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1

	Non-imminent	Species Subspecies/population Monotypic genus **Species** Subspecies/population	2 3 4 **5*** 6
Moderate to Low	Imminent Non-imminent	Monotypic genus Species Subspecies/population Monotypic genus Species Subspecies/population	7 8 9 10 11 12

Rationale for listing priority number:

Magnitude: All of the surviving occurrences of the sicklefin redhorse are restricted to relatively short reaches of the streams they occupy. Their limited distributions make them extremely vulnerable to the effects from single catastrophic events (such as toxic chemical spills, major sedimentation events, channel modification, etc.) and/or the cumulative effects of lesser impacts to their habitat and numbers. Although the majority of the streams still occupied by the species occur in areas that are presently primarily rural, many of the communities within the watersheds of these streams are experiencing increasing development pressure, both commercial and residential, and are developing plans for upgrading and improving their infrastructure (e, g., roads, water supplies, sewer/wastewater treatment systems, etc.) to provide for increased densities of development. Because of the effects this development can have on water quality and habitat suitability of the sicklefin, the magnitude of the threat to the species is high.

Imminence: Although the threats faced by the sicklefin redhorse are significant, it is not anticipated that the species will be subject to these threats in the immediate future

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted*?* No, although the threats to the species are high, because they are not imminent, emergency listing is not warranted at this time.

DESCRIPTION OF MONITORING: Dr. Robert Jenkins, Department of Biology, Roanoke College, Salem, VA, and biologists with the NC Wildlife Resources Commission, NC Division of Water Quality, NC Museum of Science and Natural History, GA Department of Natural Resources, GA Natural Heritage Program, Tennessee Valley Authority, and a few private biologists have continued conducting surveys in 2004 and 2005 for the sicklefin redhorse within known and potential range of the species. In addition, there have been some limited surveys for the species conducted by biologists with the North Carolina Department of Transportation and private consulting firms for various highway and development projects proposed within the known or potential range of the sicklefin redhorse. The data obtained from these surveys have

been incorporated into the appropriate sections above.

COORDINATION WITH STATES

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment: Information was received from one regulatory agency in NC and the State wildlife agencies in NC and GA, both states where the species is known to still survive.

Indicate which State(s) did not provide any information or comments: No new information or comments were received from TN; however, the species is no longer known to occur in TN and all known surviving occurrences of the species are isolated from their likely former range in TN by dams – natural reoccupation of likely former habitat of the species in Tennessee streams in unlikely.

LITERATURE CITED IN BACKGROUND REVIEW

Published Literature:

Bates, J. M. 1962. The impacts of impoundment on the mussel fauna of Kentucky Reservoir, Tennessee River. Am. Midl. Nat. 68:232-236.

Collier, M., R.H. Webb, and J.C. Schmidt. 1996. Dams and rivers: primer on the downstream effects of dams. U.S. Geological survey Circular 1126, Tucson, Arizona. 94 pp.

Harris, P. M., R. L. Mayden, H. S. Espinosa Perez, and F. Garcia de Leon. 2002. Phylogenetic relationships of *Moxostoma* and *Scartomyzon* (Catostomidae) based on mitochrondrial cytochrome b sequence data. Journal of Fish Biology 61:1433-1452.

Layzer, J.B., M.E. Gordon, and R.M. Anderson. 1993: Mussels: the forgotten fauna of regulated rivers. A case study of the Caney Fork. Regulated rivers: Research and Management 8:63-71.

Ligon, F.k., W.E. Dietrich, and W.J. Trush. 1995. Downstream ecological effects of dams. Bioscience 45(3):183-192.

Waters, T. F. 1995. Sediment in streams: sources, biological effects and control. American Fishery Society Monograph 7. Bethesda, MD. 251 pp.

Williams, J.D., S.L.H. Fuller, and R. Grace. 1992. Effects of impoundments on freshwater mussels (Mollusca: Bivalvia: Unionidae) in the main channel of the Black warrior and Tombigbee rivers in western Alabama. Bulletin of the Alabama Museum of Natural History 13:1-10.

Unpublished Reports:

Jenkins, R. E. 1999. Sicklefin redhorse (*Moxostoma* sp.), undescribed species of sucker (Pisces, Catostomidae) in the upper Tennessee River drainage, North Carolina and Georgia--description, aspects of biology, habitat, distribution, and population status. Unpublished report to the U.S. Fish and Wildlife Service, Asheville Field Office, Asheville, NC, and the North Carolina Wildlife Resources Commission, Raleigh, NC. 34 pp., tables 1-7, and figures 1-15.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: /s/ Jeffrey M. Fleming 11/16/2005
Acting Regional Director, Fish and Wildlife Service Date

Concur: _____ _____
Director, Fish and Wildlife Service Date

Do Not Concur: _____ _____
Director, Fish and Wildlife Service Date

Date of annual review: October 2005

Conducted by: Asheville, North Carolina Field Office